



Penetrating Neck Injuries Following a Case Report of a Successfully Healed Penetrating Neck Injuries Inflicted by a Sharp Tool

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Introduction: The penetrating neck injuries belong to the group of the most urgent conditions in medicine. Large blood vessels and nerves that connect the head with the body are situated in the neck as well as the important parts of respiratory and digestive system. The penetrating neck injuries inflicted by the sharp object cause damage to organs that are placed in the neck which directly threatens life of the injured person. Bleedings that occur in such conditions, as well as other complications, could be the immediate cause of death.

Aim: The aim of our work is to present the case of a female patient with a penetrant and perforant neck injury and the state of the hemorrhagic shock, successfully treated in our institution.

Case Report: Female patient, 37 years old, was injured by the two stabbs into the left side of the neck caused by kitchen knife. As the injury occurred 40 km from our center the first aid was administered at the regional center, so she arrived to our clinic already intubated, with heavy mouth bleeding despite tamponing of the mouth cavity, unconscious, with administered transfusion. Two

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sutured wounds were present on the left lateral side of the neck, each about 2 cm long, one along the front SCM edge, localized in its middle third and the other placed laterally to the neck line, at about 2 cm below the left ramus of the lower jaw. She immediately underwent general anesthesia and the team work was organized to explore the above mentioned wounds. Two large injuries were noticed as dominant there: penetration of the internal jugular vein in the length of 3 cm and penetration of the lateral wall of hypopharynx. Primary vein wall plastic and hypopharynx reconstruction provided satisfactory haemostasis. The success of the intervention was checked by directoscopy. The nasogastric tube was immediately placed. In the postoperative period, the patient was extubated the following day, the nasogastric tube was removed after 7 days and there were no complications detected. She was released home fully recovered on the tenth day.

Discussion and Conclusion: The penetrant and perforant neck injuries belong to the group of the most urgent conditions in medicine since they directly threatens patient's life. In taking care of these injuries, the most important thing is to secure breathing, by intubation or tracheotomy, to stop the bleeding, if not permanently, then at least temporarily, to provide for compensation of fluids by infusion or transfusion, as well as to organize safe transport to the medical institution where patient can receive final treatment. The approach to such injuries requires team work, while being aware that the size of the entering wound does not implicate the size of the injury.

Keywords: Neck; penetrant and perforate injury; treatment.

1. INTRODUCTION

The penetrating neck injuries belong to the group of the most urgent conditions in medicine. The damage could be inflicted to larynx, trachea, hypopharynx, esophagus, thyroid, blood vessels, muscles and spinal cord [1,2,3]. Fortunately, these injuries are not so frequent, since the neck is protected by the lower jaw, cervical vertebrae and thorax. According to the statistical data, frequency of the neck stabbing wounds, amounts from 5 to 10% of all trauma, while 30% of them are accompanied by injuries of the organs that are situated in the neck. Mortality rate due to those injuries was 11% during the World War I, while during the World War II, it was 7%. Today, mortality rate due to these injuries amounts from 3 to 6%, but it is somewhat higher in cases when large arterial or venous blood vessels are injured. Vascular trauma, of the large neck blood vessels is present in 25% of penetrant neck injuries and mortality rate of patients with such a type of injuries, according to the data from literature, is up to 50%. Injuries of the tracheo-bronchial tree have the frequency of 10 to 20% and mortality rate of 20% [1,2].

Historical data show that in 1552, Ambrose Pare was the first who took care of injuries of the common carotid artery and jugular vein in a soldier with traumatic neck injury. The patient survived, while the consequences were aphasia and hemiplegia. In 1803, Fleming gave a report on successful remediation of common carotid artery after five months of monitoring [4].

Etiologically, penetrant neck injuries, as well as any other type of injuries, can be intentional or unintentional (accidental). Penetrating injuries can be caused by knife, sharp instrument, scribe and firearms, e.g. projectiles. Instruments that cause the injury possess specific characteristics, which influence the surgical procedure. For instance, the stabbing wound has 10 % negative exploration finding than the injury inflicted by projectile [5].

There are two factors that determine the size of injury: weapon properties and place of injury. When considering the weapon property, the most important is its kinetic energy in interaction with tissue, while for the place of injury, it is important to notice the place of direct impact as well as possibility of tissue and organ displacement.

Clinical signs of injury can point to the type of injury as well, thus the active bleeding from the wound indicates the arterial-vascular injury, hematoma that is spreading – vascular injury, stridor – laryngeal or esophageal injury, gurgling – tracheal or esophageal injury, subcutaneous emphysema – tracheal, esophageal or pulmonary injury, oronasopharyngeal bleeding – pharyngeal injury. It is also very important to follow the vital signs since hypotension or loss of pulse and bradycardia can be signs of life threatening bleeding [6].

Penetrant neck injuries require quick intervention and they should follow logical consequences of trauma, whose priority is to secure safe breathing

path prior to everything else, as well as the control of bleeding that originates from esophagus and pharynx.

The protocol of selective approach, aimed in noticing the symptoms, is the best approach to treatment of such injuries. The treatment procedures depend on the localization of the injury [7,8].

For therapy of the penetrant neck injuries, it is very important to estimate the patient's vital condition. Each patient, in the state of shock after the penetrant neck injury, must be transported to the surgery due to the necessity of neck exploration, after the breathing path is secured, while the direct digital pressure at the injury spot must be maintained. Simultaneously, surgery is indicated for patients with large, spreading or pulsating hematoma and apparent arterial bleeding from the wound. Besides the X-ray recording, for establishing the pneumothorax or extended mediastinum, other diagnostic procedures should not be done. For patients who are not in the state of shock, principles of the selective treatment can be applied with reducing incidence of neck exploration. The procedure consists of careful determination of the injury zone and detailed objective examination with noticing the signs and symptoms pointing to vascular and aero digestive injuries. Signs and symptoms that require further diagnostic procedures, as well as all the cases of the zone II neck injuries are: stridor, dysphonia, dysphagia, incidents of cranial nerves, anamnesis data of blood loss, significant subcutaneous emphysema or pathological X-ray finding in lungs including extended or reduced mediastinum [9].

Complications of the penetrant neck injuries could be: persistent bleeding, pseudo-aneurisms, fistulas, infections, stenosis of esophagus, larynx, blood vessels, neurological deficit, thrombosis, massive air embolism [10].

2. PATIENT PRESENTATION

Female patient P.S., 37 years old, was injured by the two stabbs into the left side of the neck caused by kitchen knife. As the injury occurred 40 km from our center the first aid was administered at the regional center, so she arrived to our clinic already intubated and with Black-More tube, with heavy mouth bleeding

despite tamponing of the mouth cavity, unconscious, with administered transfusion. The clinical examination was done at the arrival, findings were the following: on the lateral side of the neck, to the left, there were two sutured wounds, each about 2 cm long, one along the front edge of the sternocleidomastoid muscle, localized in its middle third and the other placed laterally to the neck line, parallel to the left ramus of the lower jaw, at about 2 cm below. Both wounds were localized in the neck zone II.

The patient was immediately taken to the operating theatre where she underwent general anesthesia and exploration of the neck began. Two large injuries were noticed as dominant:

- laceration of the internal jugular vein in the length of 3 cm, at the front and back wall
- penetration of the lateral hypofarynx wall.

Neck exploration started with incision at the left side of the neck, from the mastoid extension, via the front edge of the SCM up to the supraclavicular pit, the carotids appeared as intact, while the bleeding stemmed from the internal jugular vein. The vein wall was penetrated in the length of 3 cm; hemostasis was tried by direct suture of the vein wall, but the bleeding continued and the foaming blood was pouring from it, which pointed to the communication of pharynx with external environment. The suture was done on the lateral wall of the hypofarynx in layers. Then the direct laryngoscopy was performed to check the surgery success, to control eventual bleeding and to see if other organs were not injured as well. Since no other injuries were found and the bleeding stopped, the nasogastric tube was placed for the feeding purposes. Laboratory findings, at the patient's arrival, were the following: RBC $1,85 \times 10^{12}$ L, hematocrit 0,174 L/L, hemoglobin 57 g/L, trombocytes 26×10^9 /L. During the intervention, the patient received transfusions and infusions. She was moved to the emergency ward and all vital parameters were monitored continuously. The following day, the patient was extubated. She was moved to the ENT Clinic ward on the third day. The nasogastric tube was removed on the seventh day. The patient was released home on the tenth day, without neurological deficits, with regular swallowing, breathing and good general condition.



Fig. 1. Patient's appearance after the finished surgical treatment



Fig. 2. Patient's appearance after the completed treatment

3. DISCUSSION

The neck connects the head to the body, it is of a cylindrical form, about 8 cm long, its area amounts from 1.5 to 1,8% of the total body area. Within such a small area, several important organs are placed (larynx, pharynx, esophagus, and thyroid gland), large blood vessels, muscles,

fasciae and skeleton (vertebrae of the spine). Penetrant and perforating injuries of the neck with injuries of neck organs belong to a group of the most severe injuries, since they cause obstruction of the breathing paths, bleeding and the state of shock. In treating these injuries, one must comply with principles of treating the individual zones of the neck.

Stabbing wounds to the neck, are usually caused by the sharp object, intentionally or unintentionally. The most frequent symptom is bleeding from the wound or from the mouth, due to injuries of blood vessels, pharynx, larynx, esophagus or trachea. In this type of injuries, the most important thing is to secure free breathing, either by intubation or tracheotomy, to stop the bleeding by digital compression or tamponing of the mouth cavity and treatment of shock. Finally, the surgical treatment of such wounds requires neck exploration in the operating theatre.

The patient with the neck injury can be either in the state of shock or the vital signs can be stable. The evaluation of the patient with the penetrant neck injuries should always start with the anti-shock therapy. The standard for surgical exploration is patients with continuous bleeding from the neck wound and signs of shock. The incision type depends on the neck zone that was hurt, as well as on structures that are situated within it. Monitoring of the specific injuries has to be confirmed and treated through the surgical exploration of the neck. These injuries are: injuries of the carotid artery, injuries of the vertebral artery, injuries of the jugular vein, laryngotracheal injuries, esophageal injuries, and injuries of nerves, thorax and thyroid.

The neck injury is considered as penetrating if the injury and penetration of the platysma occurred, the one which passes the middle line, causes the highest degree of damage. Muscle SCM separates the frontal and back regions of the neck, the majority of vital organs is placed in the frontal and lateral sides of the neck, while on the back side, only neck vertebra, bone muscles, lymphatic and nonvital vessels are situated. The narrowness of the neck can limit the vascular bleeding and thus minimize the external bleeding, but can also increase the pressure to breathing paths.

The modern approach to patients with penetrating neck injuries requires caution in interpretation of the clinical findings and adequate treatment and approach with minimally invasive treatment for successful outcome and minimal complications [11]. All the penetrant neck injuries, according to the opinion of almost all the authors, require urgent treatment, which primarily consists in securing the breathing, stopping the bleeding and fighting against shock. Injury caused by the broken windshield glass, as stated by authors, required urgent exploration of the neck and fluoroscopy helped in detecting

pieces of glass [12]. Experience of the Canadian Emergency Center for the 16-year period shows that the stabbing neck injuries are the most frequently localized in zone II of the neck, in 81% of cases. These injuries, in 67% of cases, were symptomatic because of the injuries of the large blood vessels [13]. In the procedure of the penetrating injuries of the carotid artery, the surgeon must urgently stop the active bleeding and reconstruct the blood flow, as pointed by authors who, in the male patient, performed an urgent surgery and rechanneled the thrombosed carotid artery, as a consequence of the penetrant injury to the zone II of the neck [14]. Improvement of the imaging technology, especially the CT arteriography has changed the treatment of patients with the penetrant neck injuries. Though some centers still keep the routine neck exploration for all the penetrating platysma injuries in all the neck zones, many centers in the US have accepted the doctrine of selective neck exploration based on the clinical and radiographic exploration [15]. In the case of the penetrant neck injuries by the military ammunition, which causes complex of injuries, it is a great challenge to conventional diagnostics and therapy. The biggest number of injuries was recorded in the neck zone II – 33%, out of which 62% were subjected to emergency neck exploration due to blood vessels injuries. There were 63 patients in total, during the two-year period, 21 of them had vascular injury. In 18 patients, the ligation of the blood vessel was performed, interposition of the vein or primary suture was done in 4, the PTFE graft interposition was done in 1 patient. Injuries were localised at the carotid, vertebral or nameless arteries or jugular vein. After the transport to US, all the patients were subjected to X-Ray exploration of the head and neck vascularization. The CT angiography was administered in 45 patients, including 6 patients with the injuries of the neck zone II. Forty patients (63%) were also subjected to diagnostic arteriography which detected pseudo aneurisms in 5 patients and occlusions of the carotid and vertebral arteries in 5 patients [16]. Arteriography represents a procedure of evaluation of the penetrant neck injuries, especially the helical ones, since it is noninvasive method, less risky than the classical angiography [17,18]. The large percent of the occult injuries requires complete evaluation of the exploration procedures [19].

Our patient survived such a severe penetrant neck injury thanks to timely help, securing of the breathing, stopping of bleeding and initiated fight

against shock, and of course, team work that successfully treated injuries during the neck exploration.

4. CONCLUSION

The penetrant neck injuries belong to the group of the most urgent conditions in medicine, since they lead to injuries of the vital organs and directly threatens the patient's life. For these injuries, the approach and procedures, at the moment of injury, are very significant and they consist of securing the breathing and stopping the bleeding, followed by the surgical exploration of the patient in the state of shock with symptoms of bleeding, as well as exploration in the form of angiography and F-Ray procedures in patients with stable vital signs.

The objective of our work was to present one seemingly routine case of the penetrant neck injury, which is very educational, where all the adequate treating doctrines for such injuries were applied and that resulted in the positive outcome.

The contribution of this work is to emphasize the importance of timely and adequately conducted procedures in treating the penetrating and perforating neck injuries that would lead to a favorable outcome.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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